

### Claims

1. Membrane-electrode assembly for electrochemical  
5 devices, comprising
  - an ion-conducting membrane having a front side and rear side (1),
  - a first catalyst layer (2) and a first gas diffusion layer (4) on the front side and
  - 10 - a second catalyst layer (3) and a second gas diffusion layer (5) on the rear side,wherein the first gas diffusion layer (4) has smaller planar dimensions than the ion-conducting membrane (1) and the second gas diffusion layer  
15 (5) has essentially the same planar dimensions as the ion-conducting membrane (1).
2. Membrane-electrode assembly according to Claim 1,  
wherein the catalyst layer on the front side (2)  
20 and the catalyst layer on the rear side (3) of the ion-conducting membrane (1) have different planar dimensions.
3. Membrane-electrode assembly according to Claim 1  
25 or 2, wherein the catalyst layer on the front side (2) and the catalyst layer on the rear side (3) of the ion-conducting membrane (1) have the same planar dimensions.
- 30 4. Membrane-electrode assembly according to any of Claims 1 to 3, wherein the ion-conducting membrane (1) has a surface (6) which is not supported by a gas diffusion layer on the front side.
- 35 5. Membrane-electrode assembly according to any of Claims 1 to 4, wherein the catalyst layers on the front side (2) and on the rear side (3) comprise

catalysts containing precious metals and, if appropriate, ion-conducting materials.

- 5 6. Membrane-electrode assembly according to any of Claims 1 to 5, wherein the ion-conducting membrane comprises organic polymers such as proton-conducting perfluorinated polymeric sulphonic acid compounds, doped polybenzimidazoles, polyether ketones, polysulphones or ion-conducting ceramic materials and has a thickness of from 10 to 10 200  $\mu\text{m}$ .
- 15 7. Membrane-electrode assembly according to any of Claims 1 to 6, wherein the gas diffusion layers comprise porous, electrically conductive materials such as carbon fibre paper, carbon fibre nonwovens, woven carbon fibre fabrics, metal meshes, metallized woven fabrics, etc.
- 20 8. Membrane-electrode assembly according to any of Claims 1 to 7, wherein the edge of the gas diffusion layers (4, 5) and the free surface (6) of the ion-conducting membrane (1) which is not supported by a gas diffusion layer are enclosed by 25 a sealing material (7).
- 30 9. Membrane-electrode assembly according to Claim 8, wherein the sealing material additionally impregnates the edge region (7a) of the gas diffusion layers (4, 5) to a width of at least 0.5 mm.
- 35 10. Membrane-electrode assembly according to Claim 8, wherein the sealing material comprises thermoplastic polymers from the group consisting of polyethylenes, polypropylenes, polytetrafluoroethylenes, PVDF, polyesters, polyamides, polyamide elastomers, polyimides and poly-

- urethanes, elastomers from the group consisting of silicones, silicone elastomers, EPDM, fluoro-elastomers, perfluoroelastomers, chloroprene elastomers, fluorosilicone elastomers and/or thermoset polymers from the group consisting of epoxy resins, phenolic resins and cyanoacrylates.
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11. Membrane-electrode assembly according to Claim 8, wherein the sealing material is reinforced by chemically inert, electrically insulating in-organic materials.
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12. Membrane-electrode assembly according to Claim 8, wherein the sealing material is integrally joined to a further circumferential polymer frame.
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13. Membrane-electrode assembly according to Claim 8, wherein the sealing material comprises a plurality of layers of creep-resistant polymer materials which are joined both to one another and simultaneously to the membrane-electrode assembly by means of a layer of adhesive.
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14. Membrane-electrode assembly according to Claim 13, wherein polymers having a glass transition temperature ( $T_g$ ) above 100°C are used as creep-resistant materials.
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15. Membrane-electrode assembly according to Claim 13, wherein cold curing adhesives or hot-curing adhesives from the group consisting of acrylates, cyanoacrylates, epoxy resins, EVA, polyethylene, propylene, etc., can be used as adhesive.
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16. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, which comprises joining two catalyst-coated gas
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diffusion layers to the front side and rear side of an ion-conducting membrane.

- 5 17. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, which comprises joining two gas diffusion layers which are not coated with catalyst to the front side and rear side of an ion-conducting membrane which is coated with catalyst on both sides.
- 10 18. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, wherein the surface (6) of the ion-conducting membrane (1) which is not supported by a gas  
15 diffusion layer is brought into direct contact with sealing material.
- 20 19. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, wherein the membrane-electrode assembly is brought into contact with one or more prefabricated frames of sealing material and the regions of the membrane-electrode assembly and sealing material which are in direct contact are joined under  
25 pressure by means of an electric heating pulse.
- 30 20. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, wherein curing of the sealing material is effected by means of increased pressure and/or elevated temperature or by contact with atmospheric moisture and/or by means of elevated temperature.
- 35 21. Process for producing a membrane-electrode assembly according to any of Claims 1 to 15, wherein the bonding of the sealing material to the circumferential polymer frame is effected by means

of heat-reactivateable polymers and curing takes place at elevated temperature.

22. Use of the membrane-electrode assemblies according  
5 to any of Claims 1 to 15 for producing cell stacks  
for electrochemical devices, in particular for  
fuel cells.